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In Memoriam

HERBERT J. RYSER

1923–1985

Herb Ryser was born on July 28, 1923 in Milwaukee, Wisconsin. He attended the University of Wisconsin, receiving a B.A. in 1945, an M.A. in 1947, and a Ph.D. in 1948. His doctoral thesis "Rational Vector Spaces" was written under the direction of C. J. Everett. He spent the year 1948–1949 at the Institute for Advanced Study in Princeton, and then joined the faculty of the Ohio State University as an Assistant Professor. In 1962 he left Ohio State University to accept a position at Syracuse University. In 1967 he moved to the California Institute of Technology from which he was about to take an early retirement. He died in Pasadena on July 12, 1985, just a few days before his 62nd birthday.

The rest of the story is one of a kind and gentle man, and a terrific mathematician and teacher whose legacies are his mathematical works and the many students, both graduate and undergraduate, especially the undergraduates at Caltech, who were greatly influenced by him. A large number of undergraduates at Caltech who took his combinatorics course went on to other universities to write Ph.D. theses in combinatorics and become distinguished combinatorialists themselves. The Associated Students of the California Institute of Technology voted him an award for excellence in teaching in 1976 and in 1984. Through the H. J. Ryser Scholarships for undergraduates at Caltech which have been generously endowed by his estate, many good mathematics students will continue to benefit indirectly from Herb for many years to come.

Even before leaving Wisconsin his brilliance and future promise were evident. Because he received his Ph.D. in midyear, his last semester at Wisconsin was spent as a lecturer. It was during that time that he collaborated with R. H. Bruck to prove the now famous Bruck–Ryser theorem [3] which was the first, and to this day the only, general nonexistence theorem for finite projective planes. In 1950 he and S. Chowla [6] extended the nonexistence theorem to symmetric block designs. In the 1950's and the 1960's Herb was one of a small group of people giving direction to the developing field of combinatorics, and he pioneered the use of linear algebra and the incidence matrix in combinatorics. It was during that period that he did his extensive research on

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the class $\mathfrak{A}(R, S)$ of (0, 1)-matrices with prescribed row sum vector R and column sum vector S. He proved the Gale–Ryser theorem [15] for the nonemptiness of such a class and obtained his remarkable formula for the maximal term rank for matrices in the class [16]. In a series of four papers [20, 22–24] with D. R. Fulkerson he directed his combinatorial powers to the investigation of widths, heights, and multiplicities of matrices in $\mathfrak{A}(R, S)$.

Herb pursued elegance in mathematics and he loved to discover basic and beautiful theorems. He was a master expositor and every word written was carefully and deliberately chosen. His seminal book "Combinatorial Mathematics" [25], published in 1963 by the Mathematical Association of America, was very instrumental in attracting young people to combinatorics. It is now a classic and is still often described today, more than 20 years later, as the most seductive introduction to combinatorics. The book has been translated into Russian [29], French [37], and Chinese [60].

Ryser contributed to many different parts of combinatorics, especially to the theory of combinatorial designs, finite set systems, and the permanent and other combinatorial functions. In 1966 he and W. B. Jurkat [27] produced their remarkable matrix factorizations of permanents and determinants. In a series of papers [33, 35–36, 38–40, 42, 45, 47–49, 52–53, 56–57] over 12 years he investigated block designs and their generalizations, and the solutions of the equations their incidence matrices satisfy. In [58] he gave a short and elegant proof of the Bruck–Chowla–Ryser theorem using the Witt cancellation law. In recent years he saw the great potential for the use of indeterminates in combinatorics [46, 50–51, 59, 61–63, 65]. He was active in research throughout his mathematical career, even in times of poor health. Just one week before his death, he finished the writing of our joint paper [65]. Receiving that paper, I was struck again by his extraordinary skills in mathematical exposition.

Herb was popular wherever he went and he had many friends across the country. He liked being with people but he also enjoyed his privacy. He gave much support to his graduate students and maintained contact with them over the years. They admired him greatly. He had thirteen Ph.D. students: M. F. Tinsley, R. M. Haber, R. Silverman, P. J. Nikolai, E. C. Johnsen, S. Halleck Scheick, W. G. Bridges, W. R. Henderson, C. W. Lam, R. A. Patenaude, D. Keenan, R. P. Anstee, and myself. He served as a lecturer in the Visiting Lecturers' Program of the Mathematical Association of America for about 10 years. For many years he was on the editorial board of the *Journal of Combinatorial Theory* and of the *Journal of Algebra*. He was a compassionate and generous person and made many contributions to mathematical funds and charities. He had a strong interest in art, in

particular ceramics, and his love for beautiful and rare objects was evident to those who knew him. He was a neat and extremely organized person. Having sorted through the contents of his office at Caltech, I can attest to the fact that he saved almost everything. Included among his belongings were thank-you notes for gifts given, an invitation to a spring dance given by Dr. Robert Oppenheimer at the Institute for Advanced Study, and the letter of offer for his first academic job.

Many of us have lost a dear personal friend. The mathematics community has lost a superb mathematician, but Herb's contributions to mathematics will endure. His ideas and insights in his published works will undoubtedly be the basis of much research for many years to come.

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